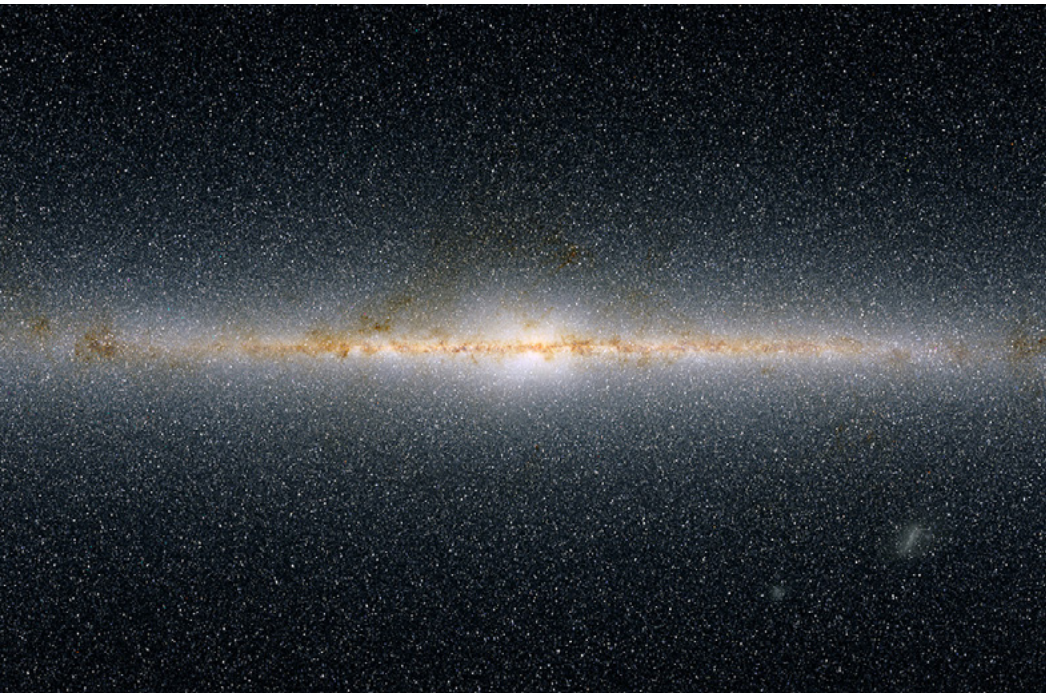
National Aeronautics and Space Administration

UNIVERSE DISCOVERY GUIDES

September

MILKY WAY GALAXY: CITY OF STARS



This view of our Milky Way Galaxy is a panoramic view of the entire sky as seen by the Two Micron All-Sky Survey. The image is centered on the core of our Galaxy, toward the constellation of Sagittarius.

IN THIS GUIDE

Night Vision Mode enables a red overlay to preserve night vision.

Night Vision Mode On

Night Vision Mode Off

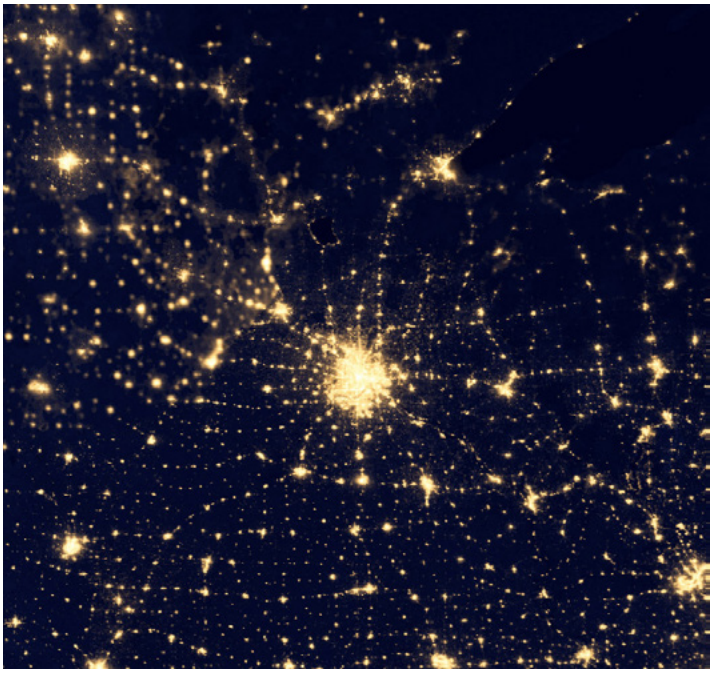
Published 2013.

The universe is a place of change. NASA missions advance our understanding of the changing universe. www.nasa.gov

MILKY WAY GALAXY: CITY OF STARS

Imagine flying in an airplane high over a large city at night. Looking down you see a lot of lights. The bright dense city center is surrounded by arms of light punctuated with smaller glowing knots. Farther out are open areas with few or no lights at all.

From your distant perspective, the whole scene looks quiet, peaceful and unchanging.



Minneapolis and surrounding area at night. Credit: NASA Earth Observatory/NOAA NGDC

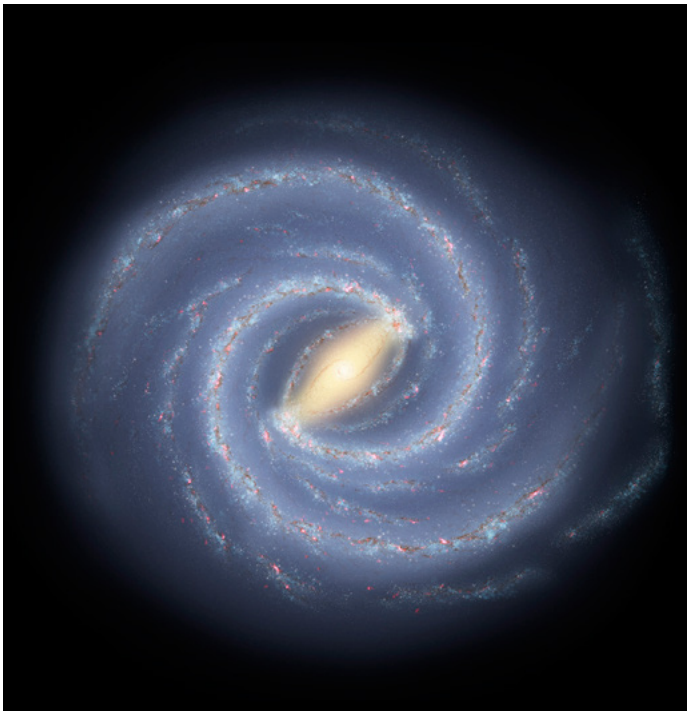
But if you could take out a large telescope and take a closer look, you'd find a bustling city that holds an abundance of activity, change and renewal. Traffic buzzes about. Office buildings, shops and streets are filled with people conducting business. Hospitals shelter babies that are being born. New buildings are being constructed on the sites of recently demolished buildings.

Looking at the surrounding knots of light you find smaller communities. They may be less densely populated, but here too you find activity and change. Homes and shopping malls are being built, new people move into communities and some people move out. Children grow up and older people pass on.

The open areas with few lights hold ranches, farms, forests, meadows, lakes and mountains. Out here, far from the city lights, people can look up and enjoy the beautiful dark skies above — where your airplane is flying overhead.

Now land back on Earth. Stand outside and look out at the stars of our Galaxy. The sky looks quiet, peaceful and unchanging. But if we look closer, we get a very different impression. NASA telescopes allow us to take that closer look into our Galaxy. We've found a bustling metropolis full of activity, change and renewal.

The densely-populated center of our Galaxy holds a massive black hole around which stars orbit at a fantastic pace. Throughout the disk of our Galaxy, large clouds of gas and dust mark the birthplaces of new stars. Hot young stars force out the gas and dust surrounding them. Aging stars expand outward and cool off as they use up their nuclear fuel. X-ray radiation blasts from sites of black holes. Radio signals mark the pulses of energy from a spinning neutron star.



Artist's rendering of the Milky Way Galaxy based on Spitzer infrared space telescope data. Credit: NASA/JPL-Caltech/R. Hurt (SSC/Caltech)

Out above the disk of our Galaxy, a few rogue stars and tight clusters of aging stars slowly orbit the center of the Galaxy. If you could be out there, you could look down on the disk of the Galaxy and see the bright dense Galaxy center surrounded by arms of stars punctuated with smaller glowing knots of newborn stars.

The peaceful-looking scene belies the bustling metropolis within.

SKY FEATURE: MILKY WAY GALAXY

How to Find it

Distance to Center of Galaxy: 26,000 light-years
To view the band of the Milky Way: A dark sky and just your eyes
Click here to jump to the full-sky September Star Map.

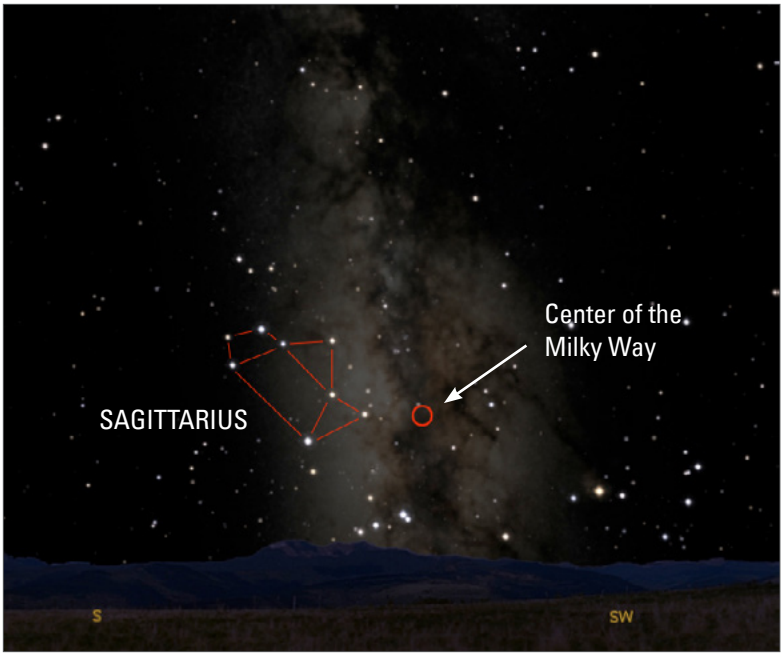
Look up at night — all the stars you see are in our own Milky Way Galaxy. The Sun and its planets, including Earth, are embedded in the Milky Way Galaxy.

Our Galaxy is a disk of stars, gas, and dust, shaped somewhat like an enormous DVD — wide, circular, and thin. We are embedded in the disk looking out through it.

On September evenings, if you can find a dark place away from bright city lights, you can see the hazy band of starlight we call the Milky Way runs from the southwestern horizon across the sky to the northeastern horizon.

When we view the hazy band of starlight, we are looking from within the disk of our Galaxy, out through the thickest part of that disk.

The center of our Galaxy is in the direction of the constellation of Sagittarius. In September, you can find that constellation above the southern horizon. Use binoculars to look in that direction and you will see a multitude of stars appearing to be crowded together because the stars are more densely packed in the center.



Just a hundred years ago, almost everyone could step outside on a clear evening and see the band of the Milky Way arching overhead. Today with our large brightly-lit cities, it is washed out due to all the streetlights. Starlight traveling thousands of years across the Galaxy is lost to our eyes in the last fraction of a second of its journey to Earth. Only by going far out in the countryside will you see that band of light. That is one of the reasons we put telescopes in remote locations, on mountaintops, and out in space.

TRY THIS!

How do I imagine the billions of stars in our Galaxy?

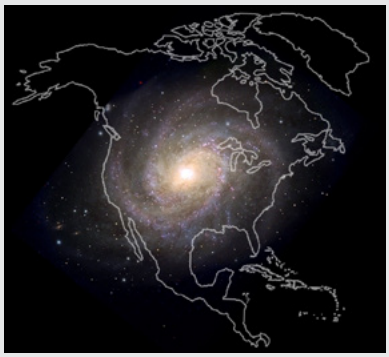
Imagine if you could shrink our Solar System, the Sun and all its planets, so it fits into the palm of your hand. On this scale the Sun would be smaller than a tiny grain of sand.

With the Solar System sitting in the palm of your hand, the **Milky Way Galaxy**, with its 200–400 billion stars, would span North America — about 2,500 miles (4,000 km) across.

Imagine a football field with a four-foot (1.3 meter) high wall built all around the edges. We'll use birdseed to represent the stars of our Galaxy. Fill the football field to the top of that wall with birdseed. That's roughly 200 billion birdseed representing 200 billion stars of our Galaxy.

For more on this model, watch the video on this page:

http://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=334



Credit: NASA/ASP

Curious about Black Holes in our Galaxy?

To learn The Truth about Black Holes, visit this interactive site:
http://amazing-space.stsci.edu/resources/explorations/blackholes/lesson/

For print-friendly information on black holes, visit:
http://teachspacescience.org/graphics/pdf/10001043.pdf

For more Hubble education and public outreach activities from the Space Telescope Science Institute, visit:
http://amazing-space.stsci.edu/

For more resources related to black holes from the Fermi Mission's education team at Sonoma State University, visit:
http://glast.sonoma.edu/teachers/blackholes/

AMAZING SPACE

http://amazing-space.stsci.edu

Fermi Gamma-ray Space Telescope

ACTIVITY: THE MILKY WAY PROJECT

Time: A few minutes to as much time as you want to spend

Age: 10 and up

Help scientists identify features of the Milky Way

The Milky Way Project (www.milkywayproject.org) has the objective to sort and measure our Galaxy. You can help by looking through images of our Galaxy from the Spitzer and Herschel telescopes.

By telling the project scientists what you see in the infrared data, those scientists can better understand how stars form.

Try the tutorial now: http://www.milkywayproject.org/tutorial/bubbles

For more citizen science projects, visit the Zooniverse website: https://www.zooniverse.org/

Looking for more Earth and Space Science formal and informal education activities?

Try out NASA's digital collection of resources at NASA Wavelength: http://nasawavelength.org

http://nasawavelength.org

CONNECT TO NASA SCIENCE

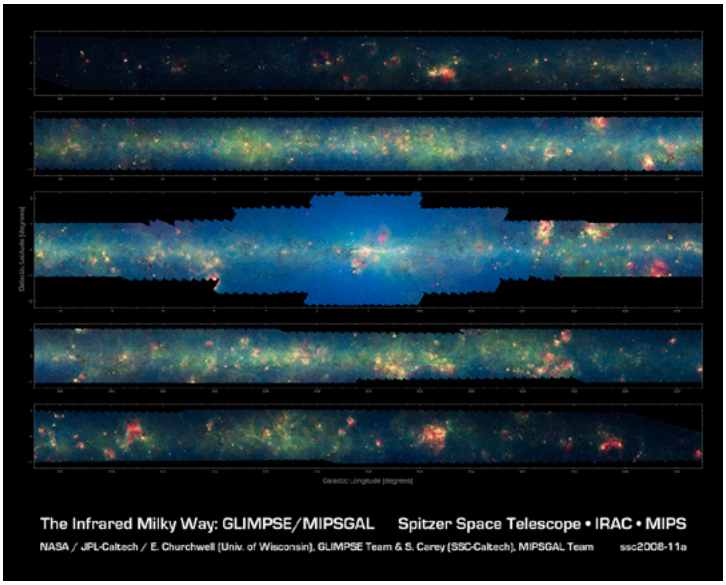
How do we know?

How do scientists know about all the activity and change in the Milky Way? When we look with just our eyes, most of our Milky Way Galaxy's stars are hidden behind thick clouds of galactic dust and gas.

Milky Way as our eyes see it. Credit: Axel Mellinger

From Earth's surface, we cannot detect much of the infrared and high-energy radiation from deep within our Galaxy. By using space telescopes, like Spitzer, Herschel and Swift, that detect this radiation, we can see through the dust and gas clouds, and discover the secrets hidden from our eyes and Earth-bound telescopes.

http://www.spitzer.caltech.edu/images/2680-ssc2008-11a-Spitzer-Finds-Clarity-in-the-Inner-Milky-Way



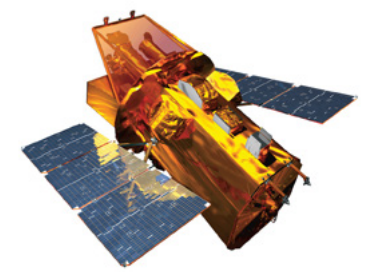
More than 800,000 frames from NASA's Spitzer Space Telescope were stitched together to create this infrared portrait of dust and stars radiating in the inner Milky Way. Credit: NASA/JPL-Caltech/Univ. of Wisconsin.

For the latest news from Spitzer, visit
http://www.spitzer.caltech.edu/news

NASA SCIENCE | ASTROPHYSICS

http://science.nasa.gov

NASA's Swift Gamma-Ray satellite discovers a new black hole in our Galaxy.



Watch the video here:

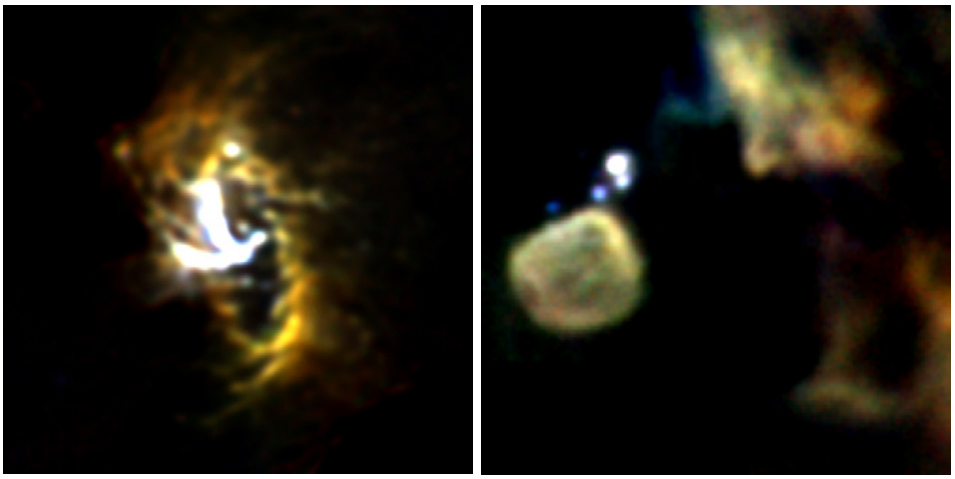
http://www.nasa.gov/mission_pages/swift/bursts/new-black-hole.html

For more news from Swift:
http://swift.gsfc.nasa.gov/docs/swift/news/

Stellar Nursery in our Galaxy's Core

NASA's SOFIA infrared telescope spots a ring of gas and dust around the Galaxy's central black hole and a neighboring cluster of infant stars.

http://www.sofia.usra.edu/News/news_2013/01_08_13/index.html



For more news from SOFIA:
http://www.sofia.usra.edu/News/news_updates.html

NASA's NuSTAR X-Ray telescope catches the Galaxy's central black hole nibbling on a snack that ventured too close.

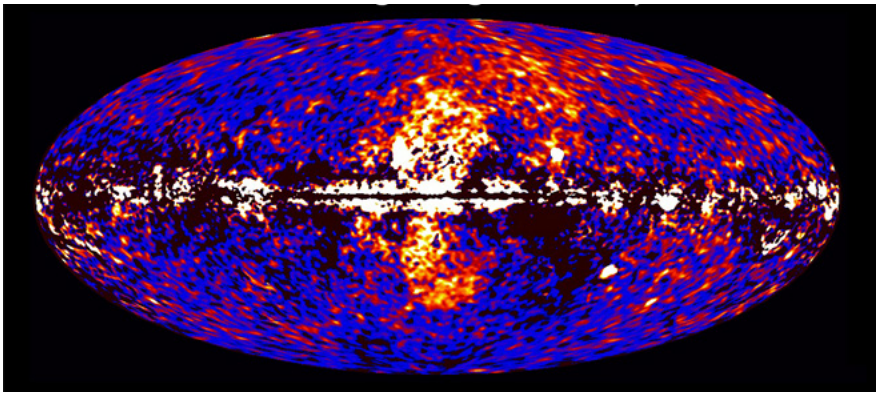
http://www.nasa.gov/mission_pages/nustar/news/nustar20121023.html

First Look at Milky Way's Monster in High-Energy X-ray Light. Credit: NASA/JPL-Caltech

For more news from NuSTAR:
http://www.nasa.gov/mission_pages/nustar/news/

NASA's Fermi Gamma-Ray telescope discovers giant energetic gamma-ray structures in our Galaxy.

http://www.nasa.gov/mission_pages/GLAST/news/new-structure.html



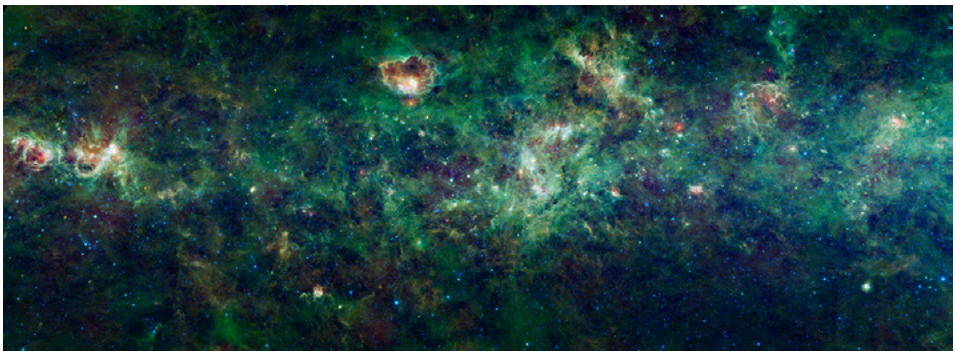
Fermi data reveal giant gamma-ray bubbles. Credit: NASA/DOE/Fermi LAT/D. Finkbeiner et al.

For more news from Fermi:
http://www.nasa.gov/mission_pages/GLAST/news/index.html

The WISE Infrared Telescope watches Galactic Fireworks

Watch the Fireworks here:

http://wise.ssl.berkeley.edu/gallery_fireworks.html



Credit: NASA/JPL-Caltech/WISE Team

For more news from WISE:
http://wise.ssl.berkeley.edu/news.html

ACKNOWLEDGEMENTS

The Universe Discovery Guides are a collaborative effort between members of the NASA Astrophysics education and public outreach (E/PO) community and the NASA Astrophysics Science Education and Public Outreach Forum. We also gratefully acknowledge the informal educators from the Astronomy from the Ground Up (AFGU) and the Sky Rangers communities who field-tested the guides.

Contributing NASA Astrophysics E/PO programs include: Afterschool Universe, Alien Earths, Astronomy Picture of the Day (APOD), the Chandra X-ray Observatory, the Cosmic Background Explorer (COBE), Cosmic Questions, the Euclid mission, Exoplanet Exploration, the Fermi Gamma-ray Space Telescope, the Galaxy Evolution Explorer (GALEX), the Herschel Space Observatory, the High Energy Astrophysics Science Archive Research Center (HEASARC), the Hubble Space Telescope, Imagine the Universe, the Infrared Processing and Analysis Center (IPAC), the James Webb Space Telescope, the Kepler Mission, the Milky Way Project, the Night Sky Network (NSN), the Nuclear Spectroscopic Telescope Array (Nu-STAR), Observing with NASA (OwN), Other Worlds, the Planck mission, PlanetQuest, Planet Hunters, the Spitzer Space Telescope, StarChild, the Stratospheric Observatory for Infrared Astronomy (SOFIA), the Swift mission, the Two Micron All-Sky Survey (2MASS), the Wide-Field Infrared Survey Explorer (WISE), the Wilkinson Microwave Anisotropy Probe (WMAP), the X-ray Multi-Mirror Mission (XMM-Newton), and Zooniverse.

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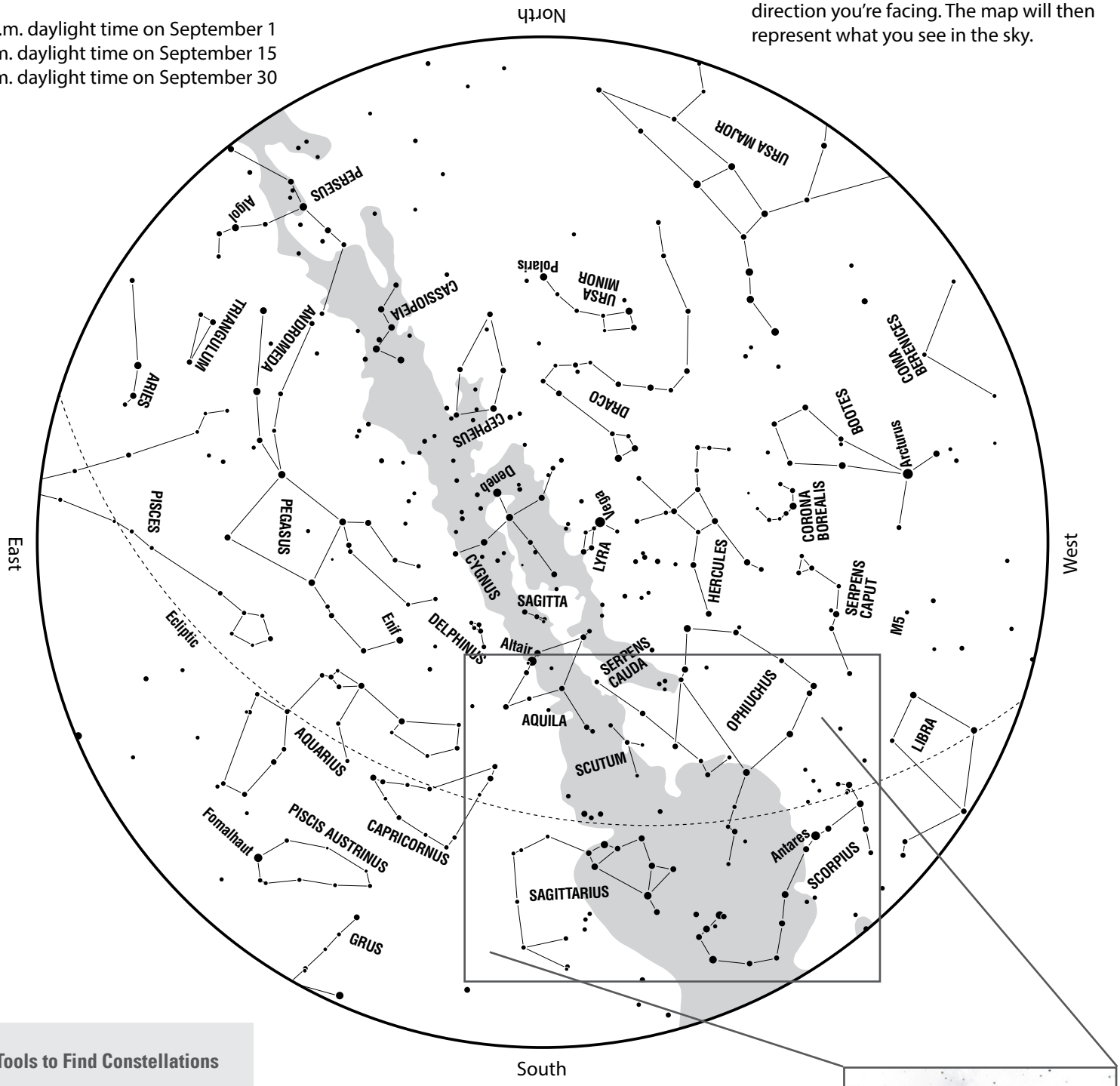
APPENDIX: SEPTEMBER STAR MAP

The all-sky map represents the night sky as seen from approximately 35° north latitude at the following times:

10 p.m. daylight time on September 1
9 p.m. daylight time on September 15
8 p.m. daylight time on September 30

To locate stars in the sky, hold the map above your head and orient it so that one of the four direction labels matches the direction you're facing. The map will then represent what you see in the sky.



Tools to Find Constellations

For mobile device users: Search your app store for "planetarium" or "sky map" to find free or low-cost apps. These help you more easily locate constellations.

View a video on how to read a star map.

September Sky Feature: Milky Way Galaxy

Jump to Sky Feature to find out about the Milky Way Galaxy